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(54) **Radio receiver tuning**

(57) A radio receiver, such as for a road vehicle, has a memory (8) that is programmed with a list representing the different frequencies associated with each of several radio stations, together with the geographical areas within which signals at those frequencies can be received. The receiver has buttons (14 to 19) which can be operated to select the radio station and the area in which the receiver is located, the receiver correspondingly tuning to the frequency associated with the selected station in the selected area. The receiver is also capable of tuning to the strongest broadcast signal by tuning through a range of frequencies at successively higher sensitivities. The receiver tuning is set when a signal above a predetermined strength is received. If the station broadcasting at that frequency is not required, the receiver labels that frequency and is inhibited from tuning to it on a subsequent scan at a higher sensitivity.

Fig.1.

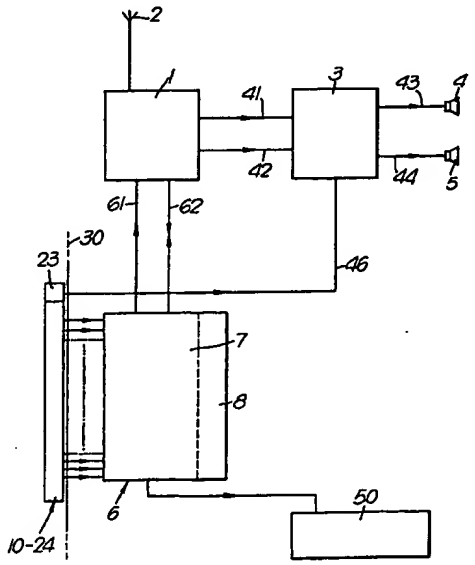

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Fig. 1.

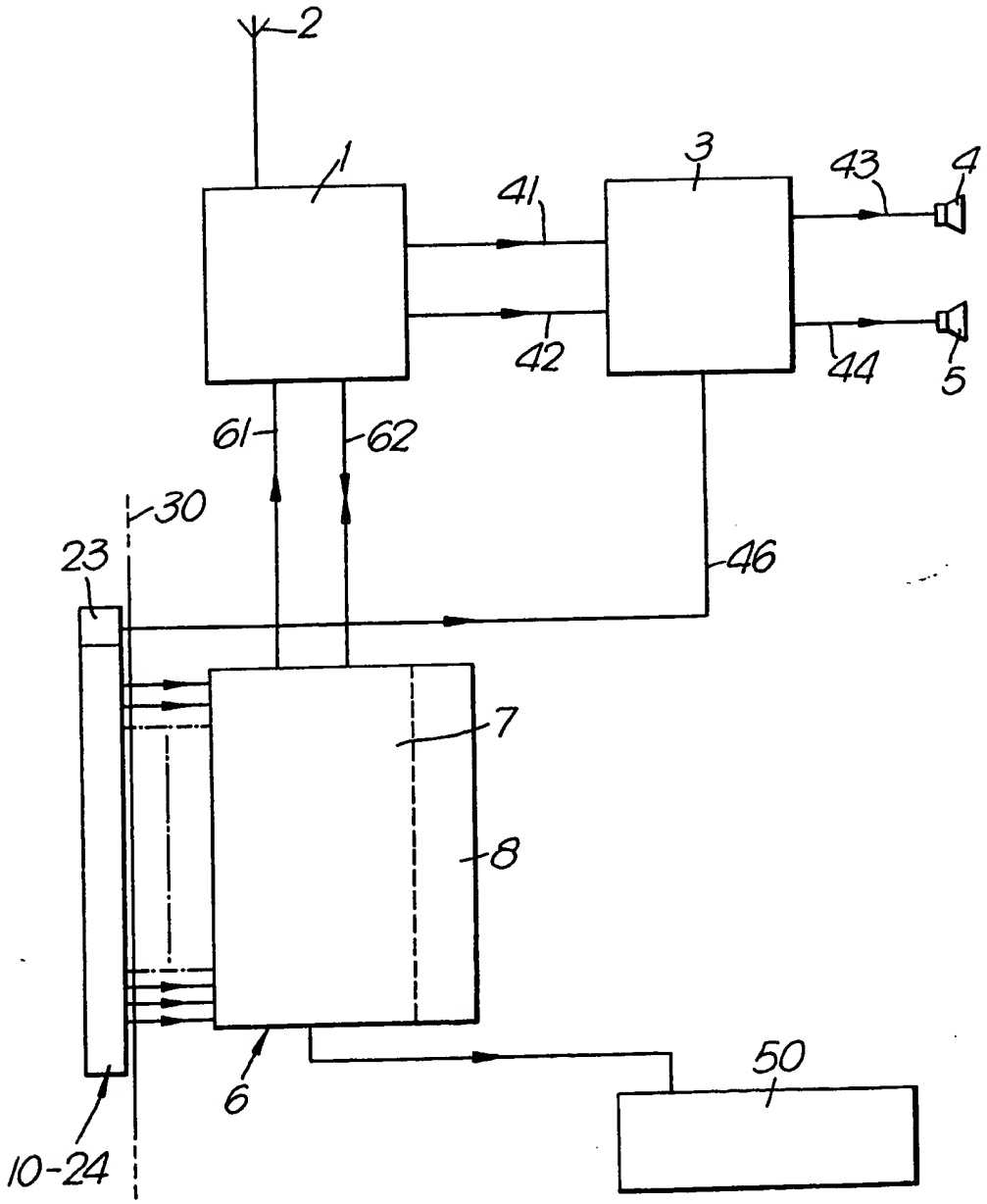

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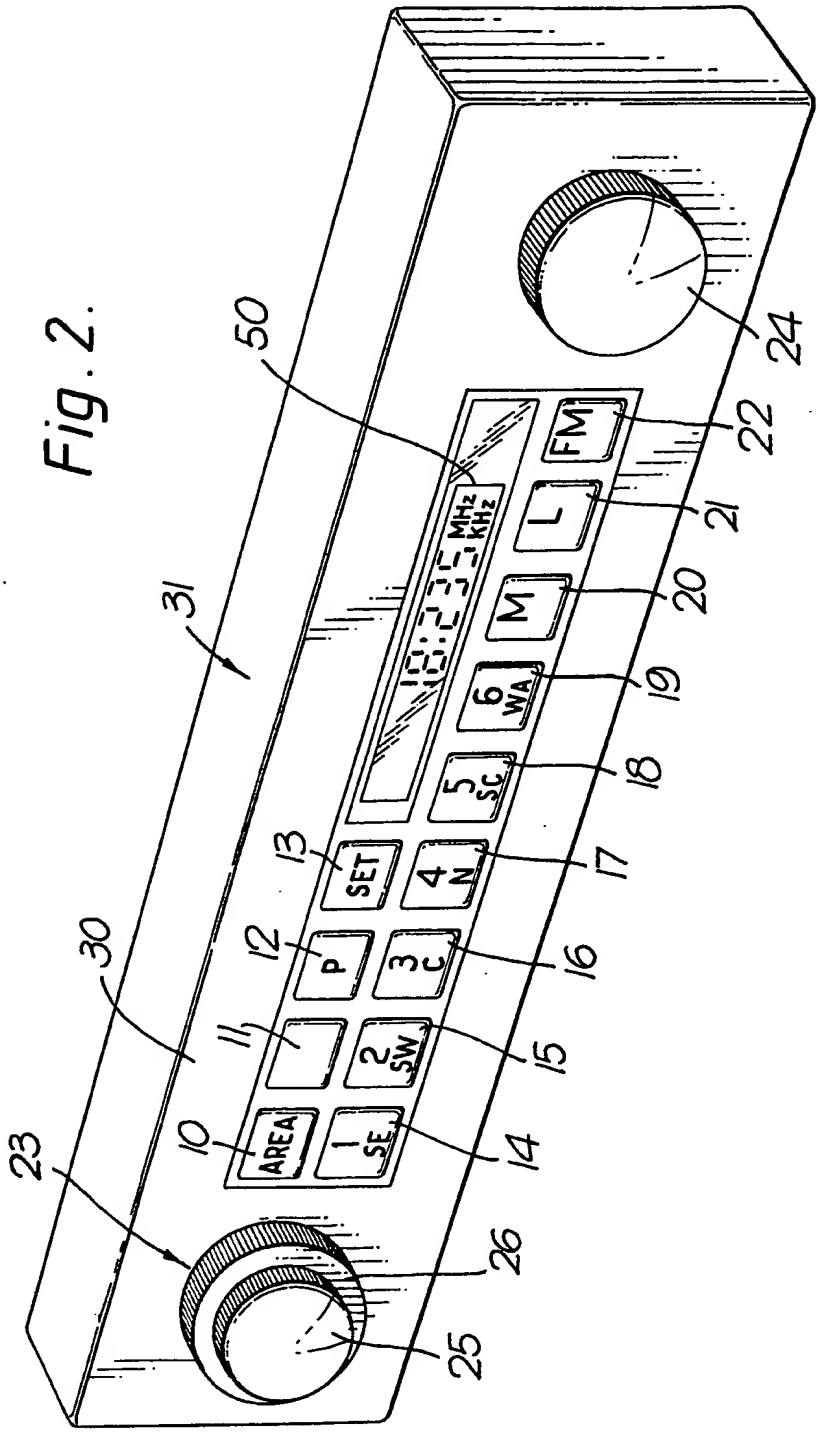
Fig. 2.


50
31
30
23
10
11
12
13
AREA
P
SET
1
SE
2
SW
3
C
4
N
5
SC
6
WA
M
L
FM
MHz
KHz
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22
21
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SPECIFICATION

Broadcast receivers

This invention relates to broadcast receivers, such as, radio or television receivers.

The invention is more particularly concerned with receivers having facility for automatic tuning whereby the receiver is tuned automatically to a broadcast station having required characteristics.

In previous conventional mechanically-tuned receivers the user is required to rotate a knob coupled to a tuning element, such as, a variable capacitor, until the receiver is tuned to the required station. Other receivers, such as, for example, described in U.K. patent specification No. 1 551 052, use push-buttons effecting tuning of the element to different frequencies.

To avoid the disadvantages of mechanical systems, such as their relatively large size and weight, electronic tuning systems have been proposed whereby the mechanical tuning element is replaced, for example, by varactors, the capacitance of which is controlled by the magnitude of the voltage applied to them. It has also been proposed to provide automatic search tuning in which tuning is continuously varied until a signal with sufficient strength is received and is then stopped to lock the receiver onto that signal. If the user requires to receive only signals from a particular station then the search can be restricted to only those frequencies associated with that station.

Difficulties have been experienced with previous arrangements, especially where used in radio receivers for road vehicles. The difficulties arise because the vehicles may travel from one geographical area, where particular radio frequencies are allocated to particular radio stations, to other geographical areas, where the same radio frequencies are allocated to different radio stations. Disadvantages also arise where there is a momentary reduction in signal strength, such as, may occur when the vehicle passes under a bridge or between buildings, since some receivers would re-tune in such circumstances with a consequent interruption of the programme being received.

It is an object of the present invention to provide a broadcast receiver which will substantially avoid the above-mentioned disadvantages and which will be relatively easy to use.

According to one aspect of the present invention there is provided a broadcast receiver including memory means arranged to store data representative of a plurality of broadcast frequencies associated with individual broadcast stations and data representative of geographical locations associated with some at least of said frequencies, said receiver being arranged to tune automatically to one or other of said frequencies associated with a broadcast station in a specified geographical location in accordance with user selection of said broadcast station.

The said geographical location may be specified in accordance with user selection of geographical location.

The receiver may be initially tuned automatically through a range of frequencies at a first sensitivity such that said receiver tuning is set to a frequency at which a broadcast signal is received above a given predetermined amplitude, and wherein, if no signal is received above said first amplitude, said receiver tunes automatically through a range of frequencies at at second sensitivity, higher than said first sensitivity, such that said receiver tuning is set to a frequency at which a broadcast signal is received above a second predetermined amplitude.

The second amplitude may be lower than the first amplitude and, or alternatively, the receiver may be arranged to tune through different ranges of frequencies in different frequency bands. For example, the receiver may tune initially through an FM band and, if no signal of sufficient strength is received may tune subsequently through an AM band.

Various other aspects of the present invention will become apparent from the following description.

A radio receiver for a vehicle will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic representation of the receiver; and

Figure 2 illustrates the front panel of the receiver.

With reference to Figure 1 and 2, the receiver includes a frequency synthesised radio unit 1 which receives broadcast signals from an aerial 2. The unit 1 is tuned to a particular broadcast frequency and supplies audio output signals via a stereo amplifier 3 to speakers 4 and 5. Tuning is effected under control of a control unit 6 in response to actuation of various buttons and knobs 10 to 24 on the front panel 30 of the receiver.

The frequency synthesised radio unit 1 is of a conventional form and the details of its construction are therefore not illustrated. In a frequency synthesised superheterodyne radio, the received radio signal is mixed with a signal from a local oscillator thereby to produce a lower frequency output signal. The frequency of the local oscillator is controlled by the output of a comparator which receives a stable reference frequency signal at one input, and at the other input the output of the local oscillator via an adjustable divider. By changing the division ratio of the divider the frequency to which the synthesiser is tuned can be adjusted.

The amplifier 3 is also of conventional design, receiving stereo-decoded audio signals on lines 41 and 42 from the radio unit 1, and may be mounted within the casing 31 of the receiver or separately at a remote location. If the broadcast signal to which the receiver is tuned is of only mono form then the signals on lines 41 and 42 will be identical. The output of the amplifier 3 is supplied via lines 43 and 44 to the speakers 4 and 5 respectively which are mounted in the vehicle at suitably spaced locations for stereo sound reproduction.

The volume, tone and balance of the amplified signals are controlled by a knob 23 on the front panel 30 of the receiver. The receiver is turned on and off, and the volume is controlled by rotating the central part 25 of the knob 23 which is coupled to a rotary potentiometer (not shown). Tone is controlled by rotating the outer ring 24 of the knob 23, whilst the stereo balance can be controlled by pulling the central part 25 away from the front panel 30 and rotating it. For clarity, the knob 23 is represented as being connected with the amplifier 3 via a single line 46 although in practice several lines would be used.

The control unit 6 includes a microprocessor or mirocomputer 7, suitably programmed to operate in the manner described in detail later. The control unit 6 supplies signals via line 61 and 62 for controlling tuning and sensitivity respectively of the radio unit 1, and receives signals via line 62 from the radio unit 1 representative of the amplitude of the received broadcast signal. The control unit 6 also includes a suitable store or read-only memory 8 containing data as to broadcast transmission frequencies. More particularly, the memory 8 contains data in tabular form, each column containing data representative of every frequency associated with each radio station.

Operation of the receiver in its various modes will now be described in greater detail.

MANUAL TUNE: Rotation of the tuning knob 24 will cause the receiver to tune along the particular waveband selected in steps of 9kHz for the Medium Wave (MW) and Long Wave (LW) bands, and for the VHF bands in steps of 50kHz. The particular frequency to which the receiver is tuned will depend on the amount by which the tuning knob 24 has been rotated. Waveband selection is performed by depressing one of the buttons 20 to 22 labelled "M", "L" and "FM" for Medium Wave, Long Wave and FM(VHF) respectively. Each time the waveband is changed in this way, the receiver will perform an AUTOMATIC SEARCH to locate a particular station in a manner described later. When the receiver has been previously tuned to a frequency by one of the other modes of operation, manual operation of the tuning knob 24 will simply increase or decrease this frequency according to which way the tuning knob is turned.

During the MANUAL TUNING operation the tuning frequency is displayed in a display panel 50 which may be a liquid crystal or light-emitting diode display, or any other suitable form. In this way, it is possible to tune the receiver either by ear, as in conventional receivers, or to a particular frequency by rotating the tuning knob 24 until that frequency appears in the panel 50.

MANUAL SEARCH: By pressing the tuning knob 24 the receiver searches up the waveband, by increasing the frequency from the last frequency tuned, until it receives a signal above a first predetermined amplitude. On finding a station, tuning stops until the tuning knob 24 is pressed again. The receiver stays tuned to this frequency if the amplitude of the received signal falls; even if it falls below the first predetermined amplitude. In this way, the receiver avoids the disadvantages of some previous receivers which only remain tuned to a particular frequency while signals above a predetermined amplitude are received and which therefore may re-tune whenever there is a reduction of signal strength. Since re-tuning can take an appreciable time to accomplish, this may cause a noticeable interruption in the audio output. This can be an especial problem with receivers used in road vehicles since momentary reduction of signal strength is a fairly common occurrence. The present receiver avoids this problem since re-tuning only occurs when the user presses the tuning knob 24 again.

If no station is found at this first sensitivity level, and providing that the search did not start from the lowest frequency in the waveband, the search of the waveband is repeated at the first sensitivity level. If no station is found on this second search, or if the first search had started at the lowest frequency, the search is repeated at a higher sensitivity for signals above a second (lower) predetermined amplitude. This operation is repeated at successively higher sensitivities until a station is found.

If the entire waveband has been searched at all sensitivities the receiver is set to the lowest frequency in the waveband, muted and an appropriate indication, such as a "0" (zero), is provided. If a station is found at one sensitivity level but this is an unwanted station, the tuning knob 24 is pressed again and the search is continued. If the tuning knob 24 is pressed within a predetermined time (such as, within ten seconds) of locking onto this station, depression of the knob causes an appropriate signal to be entered into a memory tagging the frequency of that station. When the search is continued at a higher sensitivity level it skips, that is, it does not stop on, those frequencies which were tagged at a lower sensitivity. In this way, repeated searching at different sensitivity levels does not cause the receiver to stop repeatedly at unwanted frequencies. If the tuning knob 24 is pressed after the predetermined time interval the search is continued with all tags cleared. The first sensitivity level may be set to be that at which signals are received with sufficient strength for stereo reproduction; the stereo de-multiplexer in the radio unit 1 may be made to discriminate against signals received below the signal strength corresponding to this sensitivity level.

The MANUAL SEARCH may be made in a different waveband from that to which the receiver was last set. To do this, one of the waveband buttons 20 to 22 is pressed causing the receiver to tune to, for example, the lowest frequency in the selected band, this frequency being displayed in the panel 50. Subsequent depression of the tuning knob 24 causes searching up the band from this frequency in the manner described above.

The search on MW and LW is performed by successive increments of 9kHz whilst on VHF the increments are 50kHz. It will be course be appreciated that other increments could be used.

PRESET TUNING: By actuating push-button 12, labelled "P", followed by one or other of push-buttons 14 to 19, labelled "1" to "6" the receiver is tuned to the particular frequency stored in a memory element associated with that particular push-button. The user presets the particular frequency for each push-button

14 to 19 by first tuning the receiver to the required frequency, then actuating push-button 13, labelled "SET", and then one or other of the buttons labelled "1" to "6".

AUTOMATIC SEARCH: Actuating one or other of buttons 14 to 19, labelled "1" to "6" respectively, (without previous actuation of push-button 12 ("P") as with the PRESET TUNING) initiates the AUTOMATIC SEARCH mode. As mentioned earlier, the memory 8 is programmed by the manufacturer with a list representing all the frequencies associated with each radio station. The memory 8 would not necessarily actually store each frequency as a number but could, for example, store an indication of voltage amplitude which when applied to varactor elements would cause tuning to those frequencies. In the AUTOMATIC SEARCH mode, actuation of, for example, button 15 causes the control unit 6 to scan the frequencies associated with station "2" (for example, in the U.K., B.B.C. Radio Two). As in the MANUAL SEARCH mode, this search is performed at several sensitivity levels such that the receiver is tuned to the frequency at which the strongest signal, or more accurately, one of the strongest signals, for that radio station is received. If there are any VHF frequencies associated with the station selected, the AUTOMATIC SEARCH may be first performed at varying sensitivities through the VHF band, and subsequently through other wavebands at different sensitivities if station "1" is not found in the VHF band. Alternatively the search may be arranged to change waveband at intermediate sensitivities as required. Actuation of the same station button 14 to 19 within a predetermined time causes the search to be continued as above until a station is located; actuation after the predetermined time starts the search again at the beginning of the sequence of frequencies and wavebands stored in the memory 8. In the present embodiment the search may be restricted to only one waveband by actuating one of the waveband pushbuttons 20 to 22 after selection of the station button 14 to 19. If no signal of sufficient strength is found in the selected waveband the receiver tunes to the lowest frequency in that band, shows this frequency on the display 50, and awaits further instructions. In this case actuation of the same station button 14 to 19 within a predetermined time causes the search to be continued at the beginning of the list of frequencies appropriate to the waveband selected by actuation of buttons 20 and 22.

AREA SELECTION: In the above described AUTOMATIC SEARCH the search is made through every frequency associated with the selected station. In some cases this can be a disadvantage. First because of the time taken, and secondly because, in some cases, the frequency may be associated with two different stations operating in different geographical areas. If this is the case then, with the AUTOMATIC SEARCH mode, it is possible that the receiver might tune to a different station from that desired by actuation of the station button 14 to 19. In the AREA SELECTION mode the search is confined to only those frequencies used by the station selected in one particular geographical area. To this end, the station buttons 14 to 19 serve dual purposes, and are also respectively labelled (for use in the British Isles) as follows:

Button 14: "SE"	:	South East England.
Button 15: "SW"	:	South West England.
Button 16: "C"	:	Central England.
Button 17: "N"	:	Northern England.
Button 18: "SC"	:	Scotland.
Button 19: "WA"	:	Wales and Northern Ireland.

In the AREA SELECTION mode, button 10 labelled AREA is first actuated, followed by one or other of the buttons 14 to 19 according to the geographical location of the receiver. Following this selection of the area, one of the buttons 14 to 19 is again actuated, this time for the purpose of selecting to which of the stations "1" to "6" the receiver is to be tuned. The control unit 6 then causes the receiver to be tuned to each of the frequencies associated with both the station and the geographical area selected, in a similar way to that described above for the AUTOMATIC SEARCH mode. In practice, the memory 8 contains data on every frequency associated with each station for all the geographical areas of interest. Those frequencies which are only used in some areas are appropriately labelled in the memory and are only included in the search if the appropriate area button has been actuated.

The AUTOMATIC SEARCH mode may also be geographically selective and, in this respect may be arranged such that the receiver is only tuned to those frequencies associated with broadcast transmission in one area, for example, the south east area. When the receiver is required to be tuned to frequencies of transmission in other areas the receiver would have to be operated in the AREA SELECTION mode described above, by first actuating button 10 "AREA" and then the appropriate one of the other AREA buttons 15 to 19.

It will be appreciated that the receiver may be modified in various ways. For example, some of the modes referred to above might be omitted. It would also be possible to include a noise reduction system in the receiver, such as, for example a Dolby (Registered Trade Mark) system. The receiver could be arranged to include facility for interrupting reproduction of the normal broadcast signal with road traffic information, such as using the B.B.C. Carfax system. The radio receiver could be housed in one unit with a cassette tape player. The display panel 50 could be arranged to display time information such as time of day or elapsed time, and when used with a cassette tape player, could also be arranged to indicate tape position. The display preferably also displays symbols representing the receiver mode selected, the station button number, waveband, reception of a stereo signal, and any other receiver function.

CLAIMS

1. Broadcast receiver including memory means arranged to store data representative of a plurality of broadcast frequencies associated with individual broadcast stations and data representative of geographical locations associated with some at least of said frequencies, said receiver being arranged to tune automatically to one or other of said frequencies associated with a broadcast station in a specified geographical location in accordance with user selection of said broadcast station.

2. Broadcast receiver according to Claim 1 wherein said geographical location is specified in accordance with user selection of geographical location.

3. Broadcast receiver including memory means arranged for storing data representative of a plurality of broadcast frequencies associated with individual broadcast stations, means for selecting one or other of said broadcast stations, means for storing data representative of geographical locations associated with some at least of said frequencies, means for selecting one or other geographical location, said receiver being arranged to tune to one or other of said broadcast frequencies in accordance with selection of broadcast station and geographical location.

4. Broadcast receiver according to any one of the preceding claims wherein said receiver initially tunes automatically through a range of frequencies at a first sensitivity such that said receiver tuning is set to a frequency at which a broadcast signal is received above a first predetermined amplitude, and wherein, if no signal is received above said first amplitude, said receiver tunes through a range of frequencies at a second sensitivity, higher than said first sensitivity, such that said receiver tuning is set to a frequency at which a broadcast signal is received above a second predetermined amplitude.

5. Broadcast receiver according to Claim 4, wherein said second amplitude is lower than said first amplitude.

6. Broadcast receiver according to Claim 4 or 5, wherein said receiver is arranged to be tuned through only those of a range of frequencies associated with a selected broadcast station.

7. Broadcast receiver according to any one of Claims 4 to 6, wherein said receiver is arranged to enable tuning at said first or second sensitivity to be continued through said range after reception of a signal above said first or second predetermined amplitude respectively if the signal is not required.

8. Broadcast receiver according to Claim 7, wherein said receiver is arranged to prevent tuning being set, at one sensitivity, to the same frequency as a signal which was not required at a lower sensitivity.

9. Broadcast receiver according to any of Claims 4 to 8, wherein said first sensitivity is that at which signals are received with sufficient strength for stereo reproduction.

10. Broadcast receiver according to any one of Claims 4 to 9, wherein said receiver remains tuned to a frequency at which a broadcast signal is received until the receiver is instructed to do otherwise, even if the strength of the broadcast signal falls.

11. Broadcast receiver according to any one of Claims 4 to 10, wherein said receiver is arranged to tune through a first range of frequencies in one frequency band at one sensitivity and, if no desired signal is received above a predetermined amplitude, through a second range of frequencies in another frequency band.

12. Broadcast receiver according to any one of Claims 4 to 11, including means for actuating retuning of said receiver.

13. Broadcast receiver according to Claim 12, wherein said means for actuating retuning of said receiver is arranged to retune said receiver from the frequency at which said receiver is set if retuning is demanded within a predetermined time, and from the start of the range if retuning is demanded after said predetermined time.

14. Broadcast receiver according to any one of the preceding claims, including display means arranged for indicating the frequency to which said receiver is tuned.

15. Broadcast receiver according to Claim 14, wherein said receiver is contained within a casing, and wherein said casing also includes means for playing a magnetic tape, said display means being arranged also for indicating the position of said tape.

16. Broadcast receiver for a vehicle, according to any one of the preceding claims.

17. Radio receiver substantially as hereinbefore described with reference to the accompanying drawings.

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